

Validation of the Comprehensive ICF Core Set for Osteoarthritis (OA) in Patients with Knee OA: A Singaporean Perspective

FENG XIE, NGAI-NUNG LO, HIN-PENG LEE, ALARCOS CIEZA, and SHU-CHUEN LI

ABSTRACT. *Objective.* To evaluate content validity and construct validity of the International Classification of Functioning, Disability and Health (ICF) Comprehensive Core Set for Osteoarthritis (OA) in Singapore. *Methods.* Patients with knee OA completed case report forms, which included the SF-36, Self-administered Comorbidity Questionnaire (SCQ), and Western Ontario and McMaster Universities Osteoarthritis Index (WOMAC). Health professionals completed the ICF Comprehensive Core Set for OA. Content validity was evaluated using frequency and percentage of patients with a reported problem for each ICF category, while construct validity was evaluated using Spearman correlation between the ICF categories and SF-36 and the WOMAC. *Results.* A consecutive sample of 122 patients completed this study. In *body functions*, 12 categories were documented as a problem by more than 10% of the patients, of which 7, 12, and 10 categories correlated significantly with the SF-36 Physical Component Summary (PCS), WOMAC pain, and physical function, respectively. Only s750 (Structure of lower extremity) in *body structures* was reported as a problem and correlated significantly with SF-36 and WOMAC. In *activities and participation*, 12 categories were reported as a problem by more than 10% of the patients, of which, 11, 11, and 12 correlated significantly with SF-36 PCS, WOMAC pain, and physical function, respectively. In *environmental factors*, 2 and 14 categories were documented as barrier and facilitator, respectively, by more than 10% of the patients, but none correlated significantly with SF-36 and WOMAC. *Conclusion.* The content and construct validity of the Comprehensive Core Set for OA could be supported. Some categories, especially in *environmental factors*, need to be studied further in different sociocultural contexts. (First Release Oct 15 2007; J Rheumatol 2007;34:2301–7)

Key Indexing Terms:

ICF COMPREHENSIVE CORE SET
FUNCTIONING

DISABILITY

OSTEOARTHRITIS
HEALTH

From the Department of Clinical Epidemiology and Biostatistics, McMaster University, Hamilton, Ontario, Canada, and Centre for Health Services Research, Yong Loo Lin School of Medicine, National University of Singapore; Department of Orthopaedic Surgery, Singapore General Hospital; Department of Community, Occupational, and Family Medicine, Yong Loo Lin School of Medicine, National University of Singapore; Institute for Health and Rehabilitation Sciences, ICF Research Branch of WHO CC FIC (DIMDI), Ludwig-Maximilian University, Munich, Germany; Swiss Paraplegic Research, Human Functioning Science Division, Nottwil, Switzerland; and Department of Experimental Pharmacology and Pharmacy, University of Newcastle, Newcastle, Australia.

Supported by an Academic Research Grant from the National University of Singapore, No. R-148-000-059-112.

F. Xie, PhD, Assistant Professor, Department of Clinical Epidemiology and Biostatistics, McMaster University and Research Fellow, Centre for Health Services Research, Yong Loo Lin School of Medicine, National University of Singapore; N-N. Lo, FRCS (Edin), Senior Consultant, Department of Orthopaedic Surgery, Singapore General Hospital; H-P. Lee, PhD, Professor, Department of Community, Occupational, and Family Medicine, Yong Loo Lin School of Medicine, National University of Singapore; A. Cieza, PhD, MPH, Institute for Health and Rehabilitation Sciences, ICF Research Branch of WHO CC FIC (DIMDI), Ludwig-Maximilian University, and Swiss Paraplegic Research, Human Functioning Science Division; S-C. Li, PhD, MBA, Professor, Discipline of Pharmacy and Experimental Pharmacology, University of Newcastle.

Address reprint requests to Dr. F. Xie, Department of Clinical Epidemiology and Biostatistics, McMaster University, Suite 2000, 25 Main St. West, Hamilton, Ontario L8P 1H1, Canada.
E-mail: fengxie@mcmaster.ca

Accepted for publication July 30, 2007.

Osteoarthritis (OA) is one of the most common chronic diseases around the world^{1,2}. Pain and disability are 2 main characteristics of OA that lead to a significant negative influence on patient's health status³. Therefore, functioning has been recognized as an important outcome in OA⁴⁻⁶. Many health instruments have been developed to assess the health and functioning of patients with OA, including the Western Ontario and McMaster Universities Osteoarthritis Index (WOMAC)⁷ and the Lequesne Algofunctional Index⁸, which have been widely used in clinical studies worldwide.

However, these widely used OA-specific health status measures mainly address activities far more than participation. The only areas of participation that are usually addressed in these instruments are employment and shopping. However, there are many other life areas that are restricted due to OA. Thus, a very comprehensive approach is required when evaluating the effects of OA. In addition, these instruments have also been developed according to the medical perspective and in agreement with the current concept in outcomes and quality of life research of condition-specific measures⁹, i.e., they are based on the assumption that different conditions are associated with salient patient problems in functioning. The indi-

vidual influence of the environment and personal factors, however, is scarcely taken into account¹⁰⁻¹².

The bio-psycho-social model of functioning, disability, and health of the World Health Organization (WHO) establishes the basis for a more comprehensive description of the experience of patients with a determined disease¹³. Based on this model, functioning with its components *body functions*, *body structures*, and *activities and participation* is seen in relation to the health condition under consideration, as well as *personal* and *environmental factors* (Figure 1)^{14,15}.

This bio-psycho-social view guided the development of the International Classification of Functioning, Disability and Health (ICF), which was endorsed by the World Health Assembly as a member of the WHO Family of International Classifications; it is likely to become the generally accepted framework to describe functioning and health. The ICF is intended for use in multiple sectors including health, education, insurance, labor, economics, health and disability policy, and statistics. In the clinical context, it is intended for use in needs assessment, matching interventions to specific health states, rehabilitation, and outcome evaluation. With the ICF, not only an etiologically neutral framework, but a globally agreed-on language and a classification are available to describe functioning on both individual and population levels and from the perspective of both the patient and health professionals¹³⁻¹⁶.

The ICF contains more than 1400 ICF categories, each allotted to the named components, with the exception of *personal factors*, which have not yet been classified. Thus it has to be tailored to suit these specific applications¹⁶. The ICF Core Sets have thus been developed in a formal decision-making and consensus based process integrating evidence gathered from preliminary studies for a number of the most burdensome chronic health conditions, including OA¹⁶.

The ICF Core Sets for patients with a health condition represent a selection of ICF categories out of the whole classification that can serve as minimal standards for the reporting of functioning and health for clinical studies and clinical encounters (the Brief Core Set) or as standards for multiprofessional, comprehensive assessment (the Comprehensive Core Set)

under consideration of influential environmental factors. The current version of the ICF Comprehensive Core Set for OA includes 55 categories at the second level of the classification, which describes the typical spectrum of problems in functioning among patients with OA.

The ICF Comprehensive Core Set for OA is now undergoing worldwide testing and validation through an international multicentre validation study. The objective of our study was to evaluate content validity and construct validity of the ICF Comprehensive Core Set for OA from the perspective of patients with knee OA in Singapore.

MATERIALS AND METHODS

Study design. This was a cross-sectional study in Singapore. The study protocol and informed consent forms were approved by the Institutional Review Board of the Singapore General Hospital.

Patients. The study was performed with a consecutive sample of patients with knee OA recruited from the Singapore General Hospital from August to October 2005. Patients were eligible if they were diagnosed with knee OA based on the American College of Rheumatology clinical and radiographic criteria for knee OA^{5,6} and consented to participate.

Data collection. Each patient completed the Case Report Form for Patients, which includes the Short-Form 36 Health Survey (SF-36), the Self-administered Comorbidity Questionnaire, and the WOMAC. Simultaneously, according to the health status of each patient, a trained health professional completed the Case Report Form for Health Professionals, which includes the ICF Comprehensive Core Set for OA and queries sociodemographic characteristics of patients.

Instruments. The SF-36 is one of the most widely used generic health status measurements worldwide. It contains 36 items that measure perceived health in 8 scales, namely, physical functioning, role-physical, bodily pain, general health, vitality, social functioning, role-emotional, and mental health, with higher scores (range 0–100) reflecting better perceived health¹⁷. Additionally, 2 summary scales can also be obtained: the Physical Component Summary (PCS) score and the Mental Component Summary (MCS) score.

The Self-administered Comorbidity Questionnaire is used to assess comorbidity for clinical and health services research¹⁸. Patients were first asked whether they have problems with each of the listed health conditions. If the answer was yes, patients were additionally asked whether they were receiving treatment for the condition and whether the problem limited their activities.

The WOMAC, a 24-item disease-specific functioning measurement, consists of 3 domains, namely, pain, stiffness, and physical function^{7,19}. Each of these 24 items is graded on a 5-point Likert scale. The domain score calculated by summing constituent item scores was converted to a score ranging from 0 to 100, with higher scores reflecting less pain and stiffness and better physical function⁷.

The ICF Comprehensive Core Set for OA contains a list of 55 ICF categories organized into 4 different components: *body functions*, *body structures*, *activities and participation*, and *environmental factors*¹⁶. The ICF categories are designated by the letters b (body functions), s (body structures), d (activities and participation), and e (environmental factors), followed by a numeric code starting with the chapter number (1 digit), then by the second level (2 digits), and the third and fourth levels (1 digit each). Within each component, the categories are arranged in a stem/branch/leaf scheme. Consequently, a higher level category shares the attributes of the lower-level categories to which it belongs²⁰. The 55 categories of the ICF Comprehensive Core Set for OA consist of 13 categories from body functions, 6 from body structures, 19 from activities and participation, and 17 from environmental factors.

To evaluate the extent of a patient's problem in each of the ICF categories, a generic qualifier scale is used. The qualifier scale of the components *body functions*, *body structures*, and *activities and participation* has 5 response

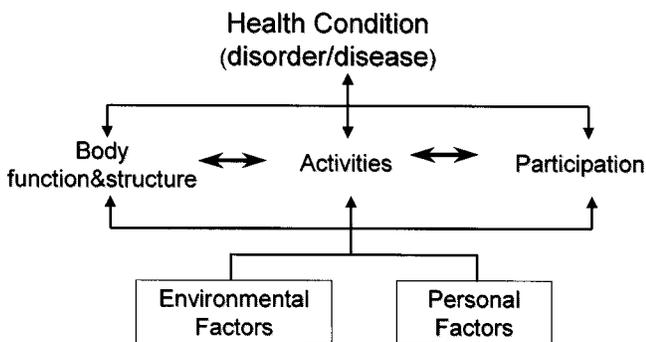


Figure 1. The current framework of functioning, disability, and health of the ICF.

options, each ranging from 0 to 4 to represent no, mild, moderate, and severe complete impairment or difficulty. The qualifier scale of the component *environmental factors* has 9 response options ranging from -4 to +4. A specific environmental factor can be a barrier (-1 to -4), or a facilitator (1 to 4), or can have no influence (0) on a patient's life. If a factor has an influence, the extent of the influence (either positive or negative) can be coded as mild, moderate, severe, or complete. In addition, there are the response options "8 (not specified)" and "9 (not applicable)". In this study, broad ranges of percentages provided by the WHO were used as a reference system to quantify the problems of the patients in each of the different ICF categories or the extent to which a determined environmental factor is a barrier or a facilitator.

Statistical analysis. All data analyses were based on the study protocol developed by the WHO ICF research team²¹. Data were entered into a Microsoft Excel Spreadsheet and analyzed using SPSS 14.0 (SPSS Inc., Chicago, IL, USA).

Descriptive statistics were used to define the study population and describe the health status of the patients based on the SF-36 and the WOMAC. The ICF qualifier 9 ("not applicable") was recoded to 0 ("no problem") based on the assumption that if a determined ICF category is not applicable to a patient, it is not a problem for the patient. When presenting number and percentage of patients who reported that an ICF category was a problem for them, the response options 1 to 4 were collapsed in *body functions*, *body structures*, and *activities and participation*, while for the component of *environmental factors*, the response options from -1 to -4 and the response options 1 to 4 were collapsed.

Content validity of the Comprehensive Core Set was evaluated using the frequency and percentage of patients who had a problem for each category. The frequency and percentage of patients who had reported the category as a barrier or a facilitator were calculated in *environmental factors*. A threshold of 10% was applied to evaluate the content validity based on the protocol developed by the WHO ICF research branch²¹. In addition, any areas of functioning reported as important by the patients but not covered by the ICF Core Set were documented by the health professionals and translated into the ICF language based on established linking rules.

Spearman correlation coefficients between the categories in the ICF Comprehensive Core Set (using original ratings without collapsing) and in SF-36 PCS and MCS and WOMAC scores were calculated to evaluate the construct validity of the core set. Convergent construct validity of the core set was evaluated by the assumption that the ICF categories in *body functions* and *activities and participation* would correlate significantly with the SF-36 PCS and WOMAC pain and physical function scales, as they measure a similar health construct (i.e., physical health); while divergent construct validity of the core set was evaluated by the assumption of nonsignificant correlation between the categories in these 2 components and SF-36 MCS, as they measure dissimilar health constructs (i.e., physical health vs mental health), with the exception of *b152* (Emotional function), which is assumed to correlate significantly with the SF-36 MCS.

RESULTS

A consecutive sample of 122 patients with knee OA was included in this study, of which 79% were female. The mean age of patients was 65 years, with a mean duration of knee OA of 6 years. The majority of patients were ethnic Chinese (91%), married (88%), retired or worked as a homemaker (81%), lived with their family (89%), and had comorbidities (82%) (Table 1).

Patients' health status is also described in Table 1. The lowest mean score was for the SF-36 role-physical scale and the highest for the SF-36 general health scale. In the summary scores, patients reported significant limitations in their physical health rather than in mental health. The mean scores were 64.5, 61.2, and 60.6 for WOMAC pain, stiffness, and physical function, respectively.

Table 1. Characteristics and health status of patients (n = 122).

Characteristics	No. (%) [*]
Mean (SD) age, yrs	65 (10.9)
Female	96 (78.7)
Ethnicity	
Chinese	111 (90.9)
Malay	3 (2.5)
Indian	5 (4.1)
Other	3 (2.5)
Married	105 (88.2)
Education, yrs, mean (SD)	5 (5.4)
Retired or homemaker	98 (80.9)
Body mass index, mean (SD)	28 (4.5)
Presence of chronic medical conditions	88 (82.1)
Knee	
Right	69 (56.6)
Left	52 (42.6)
Both	1 (0.8)
Duration of OA, mean (SD) yrs	6 (4.9)
Living alone	14 (11.5)
SF-36 scale scores, mean (SD)	
Physical functioning	29.0 (20.8)
Role-physical	19.5 (33.9)
Bodily pain	43.7 (25.1)
General health	69.4 (18.4)
Vitality	57.1 (22.9)
Social functioning	57.7 (29.3)
Role-emotional	66.9 (41.9)
Mental health	71.7 (21.3)
PCS score	29.9 (8.6)
MCS score	52.9 (11.3)
WOMAC scale scores, mean (SD)	
Pain	64.5 (18.4)
Stiffness	61.2 (26.9)
Physical function	60.6 (17.0)

^{*} Unless indicated otherwise. PCS: Physical Component Summary; MCS: Mental Component Summary; OA: osteoarthritis; WOMAC: Western Ontario and McMaster Universities Osteoarthritis Index.

In the *body functions* component, all categories were documented as a problem by more than 30% of the patients, with the exception of only *b280* (Sensation of pain). Seven categories in this component correlated significantly with SF-36 PCS score, while one category (*b152*, Emotional functions) correlated significantly with the SF-36 MCS score (Table 2). In contrast, all categories correlated significantly with the WOMAC pain scale. Of 13 categories in this component, 5 and 10 correlated significantly with the WOMAC stiffness and physical function scales, respectively.

In the *body structures* component, only one category (*s750*, Structure of lower extremity) was identified as a problem by more than 10% of the patients. Additionally, only this category correlated significantly with the SF-36 PCS and 3 scales of the WOMAC (Table 2).

In the *activities and participation* component (Table 3), 11 categories — *d410* (Changing basic body position), *d415* (Maintaining a body position), *d430* (Lifting and carrying objects), *d450* (Walking), *d455* (Moving around), *d470*

Table 2. Correlations between ICF categories in the Comprehensive Core Set for OA and SF-36 and WOMAC scores (*body functions* and *body structures* components).

Component	No. (%) [†]	SF-36		Pain	WOMAC	
		PCS	MCS		Stiffness	Physical Function
Body functions						
b130 Energy and drive	59 (45.9)	-0.16	-0.10	-0.20*	-0.25**	-0.27**
b134 Sleep	70 (57.4)	-0.23*	0.04	-0.36**	-0.22*	-0.35**
b152 Emotional	67 (54.9)	-0.09	-0.22*	-0.39**	-0.18	-0.34**
b280 Sensation of pain	11 (9.0)	-0.11	-0.12	-0.19*	-0.05	-0.17
b710 Mobility of joint	122 (100.0)	-0.24**	-0.14	-0.33**	-0.13	-0.29**
b715 Stability of joint	121 (99.2)	-0.23**	-0.12	-0.38**	-0.17	-0.29**
b720 Mobility of bone	75 (61.5)	-0.13	-0.08	-0.21*	-0.07	-0.13
b730 Muscle power	117 (95.9)	-0.34**	0.01	-0.37**	-0.20*	-0.37**
b735 Muscle tone	108 (88.5)	-0.32**	0.05	-0.39**	-0.18*	-0.42**
b740 Muscle endurance	108 (88.5)	-0.27**	0.05	-0.26**	-0.11	-0.37**
b760 Control of voluntary movement	60 (49.2)	-0.12	-0.07	-0.25**	-0.08	-0.24**
b770 Gait pattern	121 (99.2)	-0.24**	-0.17	-0.34**	-0.14	-0.31**
b780 Sensations related to muscles and movement	42 (34.4)	-0.04	-0.11	-0.20*	-0.26**	-0.07
Body structures						
s720 Shoulder region	1 (0.8)	-0.03	-0.03	0.03	-0.08	0.05
s730 Upper extremity	2 (1.6)	-0.06	0.05	0.13	-0.07	0.12
s740 Pelvic region	6 (4.9)	0.01	0.03	0.14	-0.05	0.11
s750 Lower extremity	120 (98.4)	-0.18*	-0.17	-0.43**	-0.28**	-0.35**
s770 Additional musculoskeletal structures related to movement	4 (3.3)	0.01	-0.16	-0.06	-0.18*	-0.12
s799 Structures related to movement, unspecified	3 (2.5)	-0.01	-0.05	-0.03	-0.15	-0.08

[†] Number (%) of patients reporting the impairment for the corresponding ICF category. * $p < 0.05$; ** $p < 0.01$. ICF: International Classification of Functioning, Disability and Health; WOMAC: Western Ontario and McMaster Universities Osteoarthritis Index; PCS: Physical Component Summary; MCS: Mental Component Summary.

(Using transportation), *d530* (Toileting), *d620* (Acquisition of goods and services), *d640* (Doing housework), *d910* (Community life), and *d920* (Recreation and leisure) — were documented as a problem by more than 40% of the patients. All these categories correlated significantly with SF-36 PCS and the scales of the WOMAC. *d510* (Washing oneself) was reported by 20.4% of the patients, which correlated significantly with SF-36 PCS and WOMAC physical function. The remaining categories, reported by less than 10% of patients, did not correlate significantly with either the SF-36 or the WOMAC. All categories in this component correlated insignificantly with the SF-36 MCS, with the exception of *d450*, *d455*, *d470*, *d530*, and *d920* (Table 3).

In the *environmental factors* component, all categories were reported as a facilitator by more than 10% of the patients, with the exception of *e135* (Products and technology for employment), *e225* (Climate), and *e460* (Societal attitudes) (Table 4). Two categories, *e225* (Climate) and *e540* (Transportation services, systems and policies), were identified as a barrier by 12.3% and 44.3% of patients, respectively. Three categories (*e115*, *e120*, *e135*) correlated significantly with the SF-36 PCS, 4 (*e120*, *e340*, *e355*, *e540*) with the

SF-36 MCS, and 2 each with the WOMAC pain and stiffness scales, respectively (Table 4).

No patient reported that any important area related to health and functioning was missed by this core set.

DISCUSSION

In this study, the ICF Comprehensive Core Set for OA generally demonstrated good content validity and construct validity in patients with knee OA in Singapore. To our knowledge, this is the first study to quantitatively validate the ICF Comprehensive Core Set for OA, which, together with the qualitative validation for the same population²², specifically complements the development of the core set.

Pain is well known as one of the main characteristics in knee OA that leads to a significant negative effect on patients' daily lives^{5,6,23}. It has been investigated by many generic and OA-specific health measurements including the SF-36 and the WOMAC^{8,24-28}. However, only 10% of patients reported impairment on category *b280* (Sensation of pain) in the *body functions* component. Further, the correlations of this category with the SF-36 PCS and the WOMAC pain and physical function scales were relatively low. The possible explanation

Table 3. Correlations between the ICF categories in the Comprehensive Core Set for OA and SF-36 and WOMAC scores (activities and participation component).

Component	No. (%) [†]	SF-36		Pain	WOMAC	
		PCS	MCS		Stiffness	Physical Function
Activities and participation						
d410 Changing basic body position	122 (100)	-0.28**	0.05	-0.31**	-0.07	-0.34**
d415 Maintaining a body position	121 (99.2)	-0.27**	-0.02	-0.43**	-0.13	-0.41**
d430 Lifting and carrying objects	120 (98.4)	-0.34**	-0.07	-0.40**	-0.29**	-0.44**
d440 Fine hand use	7 (5.7)	-0.11	-0.11	-0.04	-0.16	-0.14
d445 Hand and arm use	9 (7.4)	-0.12	-0.06	-0.14	-0.03	-0.15
d450 Walking	121 (99.2)	-0.28**	-0.21*	-0.36**	-0.32**	-0.34**
d455 Moving around	121 (99.2)	-0.16	-0.18*	-0.29**	-0.05	-0.34**
d470 Using transportation	112 (91.8)	-0.31**	-0.23*	-0.44**	-0.24**	-0.46**
d475 Driving	4 (3.3)	-0.08	0.15	-0.03	0.04	-0.03
d510 Washing oneself	30 (20.4)	-0.21*	-0.11	-0.16	-0.11	-0.28**
d530 Toileting	110 (90.2)	-0.23*	-0.18*	-0.31**	-0.27**	-0.35**
d540 Dressing	7 (5.7)	-0.16	-0.16	-0.12	-0.06	-0.23*
d620 Acquisition of goods and services	112 (91.8)	-0.32**	-0.17	-0.33**	-0.30**	-0.46**
d640 Doing housework	108 (88.5)	-0.34**	-0.04	-0.43**	-0.15	-0.46**
d660 Assisting others	5 (4.1)	0.08	-0.11	-0.04	0.11	-0.10
d770 Intimate relationships	2 (1.6)	0.13	-0.00	0.01	0.06	0.03
d850 Remunerative employment	8 (6.6)	-0.16	-0.07	-0.21*	-0.16	-0.18*
d910 Community life	51 (41.8)	-0.36**	-0.16	-0.50**	-0.28**	-0.44**
d920 Recreation and leisure	116 (95.1)	-0.32**	-0.23*	-0.51**	-0.28**	-0.54**

[†] Number (percentage) of patients reported the impairment for the corresponding ICF category. * p < 0.05; ** p < 0.01. ICF: International Classification of Functioning, Disability and Health; WOMAC: Western Ontario and McMaster Universities Osteoarthritis Index; PCS: Physical Component Summary; MCS: Mental Component Summary.

for this might be the definition for this category (*Sensation of unpleasant feeling indicating potential or actual damage to some body structure*), which is not very specific and detailed, and which may lead to misunderstanding. Besides pain, other unpleasant feelings such as stiffness and instability are also common in OA, based on the feedback from participants and health professionals. Therefore, we suggest rephrasing this category to differentiate pain from other feelings in OA.

In the category *body structures*, it is not surprising that only item *s750* (Structure of lower extremity) showed good content validity and construct validity, as the sample population in the study comprised patients with knee OA. As OA can affect many joints (e.g., hip and hand), different types of OA that involve different joints would have different effects on functioning of patients. That might be the main reason for the less satisfactory validity observed for categories in *body structures* and *activities and participation*, for example, *s720* (Structure of shoulder region), *s730* (Structure of upper extremity), *s740* (Structure of pelvic region), *d440* (Fine hand use), *d445* (Hand and arm use), and *d540* (Dressing). It may therefore be important and useful to develop subsets of the ICF representing the experience of different types of OA.

The majority of categories in *activities and participation* also demonstrated good content validity and construct validity. However, *d440*, *d445*, and *d540* are mainly related to the

types of OA involving the upper extremities, as discussed previously. *d475* (Driving), *d660* (Assisting others), *d770* (Intimate relationship), and *d850* (Remunerative employment) were less frequently reported by the patients, and correlated weakly with generic or disease-specific measures. As most patients with OA are older and retired, the categories of driving, assisting others, and remunerative employment may not be applicable in this population. In the Asian sociocultural context, people are reluctant to talk about their intimate relationships, especially the elderly, which may explain that fewer patients reported any problem in the category *d770*. Caution should be used in including these sensitive questions in the ICF Core Set, especially in the Asian sociocultural context.

Most of the categories within *environmental factors* were reported as facilitators. Interestingly, we observed 2 conflicting findings for this component. From the perspective of patients, the environmental effects were important, while the correlations of these categories with the generic and disease-specific measures were relatively low. However, this may demonstrate the value of the *environmental factors* category in the ICF: it measures concepts that cannot be determined by traditional health status or functioning measurements.

Currently, candidate categories for a generic ICF Core Set have been identified based on a multicenter, cross-sectional validation study on 12 chronic health conditions including

Table 4. Correlations between the ICF categories in Comprehensive Core Set for OA and SF-36 and WOMAC scores (*environmental factors* component).

Component	N (%) [†]		SF-36			WOMAC	
	Barrier	Facilitator	PCS	MCS	Pain	Stiffness	Physical Function
Environmental factors							
e110 Products or substances for personal consumption	0 (0)	49 (40.2)	0.13	-0.14	-0.10	0.06	0.01
e115 Products and technology for personal use in daily living	0 (0)	54 (44.3)	0.20*	-0.17	-0.06	0.04	0.04
e120 Transportation	2 (1.6)	79 (64.8)	0.20*	-0.18*	0.05	0.04	0.09
e135 Products and technology for employment	0 (0)	6 (4.9)	-0.18*	-0.05	-0.16	-0.15	-0.10
e150 Design, construction and building products and technology of buildings for public use	0 (0)	78 (63.9)	0.07	-0.05	-0.06	-0.11	-0.09
e155 Design, construction and building products and technology of buildings for private use	1 (0.8)	76 (62.3)	0.04	-0.05	-0.09	-0.07	-0.09
e225 Climate	15 (12.3)	3 (2.5)	0.07	-0.15	-0.15	0.13	-0.08
e310 Immediate family	1 (0.8)	101 (82.8)	-0.10	-0.09	-0.16	0.11	-0.04
e320 Friends	0 (0)	105 (86.1)	-0.12	-0.01	-0.19*	0.09	-0.13
e340 Personal care providers and personal assistants	0 (0)	52 (42.6)	0.01	-0.27**	-0.13	0.02	-0.06
e355 Health professionals	1 (0.8)	118 (96.7)	-0.09	-0.20*	-0.05	0.09	-0.09
e410 Individual attitudes of immediate family members	2 (1.6)	104 (85.2)	0.01	-0.07	-0.18*	-0.20*	-0.14
e450 Individual attitudes of health professionals	1 (0.8)	117 (95.9)	-0.04	0.02	-0.02	-0.04	-0.09
e460 Societal attitudes	2 (1.6)	12 (9.8)	0.04	-0.05	-0.02	0.20*	0.09
e540 Transportation services, systems, and policies	54 (44.3)	30 (24.6)	0.04	-0.22*	0.08	-0.02	0.14
e575 General social support services, systems, and policies	4 (3.3)	60 (49.2)	0.02	-0.08	-0.10	-0.12	-0.01
e580 Health services, systems, and policies	5 (4.1)	98 (80.3)	-0.00	-0.10	-0.16	-0.04	-0.07

* $p < 0.05$; ** $p < 0.01$. [†] Number (percentage) of patients reported the corresponding ICF category either as barrier or as facilitator. ICF: International Classification of Functioning, Disability and Health; WOMAC: Western Ontario and McMaster Universities Osteoarthritis Index; PCS: Physical Component Summary; MCS: Mental Component Summary.

OA²¹. Out of 13 categories in the generic ICF Core Set, 9 are also relevant from the perspective of patients with knee OA, namely, *b130* (Energy and drive function), *b152* (Emotional functions), *b280* (Sensation of pain), *b730* (Muscle power functions), *d450* (Walking), *d620* (Acquisition of goods and services), *d640* (Doing housework), *d660* (Assisting others), and *d920* (Recreation and leisure). This will increase the comparability of the core set for OA with the core sets for other chronic health conditions.

We acknowledge several limitations in this study. First, in the evaluation of construct validity, some *a priori* hypotheses of the magnitude and direction of the expected correlations between the ICF and the SF-36 and the WOMAC would be useful. However, due to lack of current knowledge and publications, we did not develop these hypotheses here. Second, only patients with knee OA were studied, which may explain why several categories in the core set have demonstrated less satisfactory content and construct validity. As other types of OA were rarely seen in Singapore, it is difficult to recruit a meaningful sample of patients with other types of OA, despite extensive effort. Nevertheless, we recommend that ICF validation studies in other countries should recruit a sample of OA patients that represents the real distribution of different types of OA in that setting. This would be a comprehensive way to evaluate the performance of the ICF Core Set in OA patients within a study. Third, the sample size is relatively small and

the sociocultural context is relatively different from that of Western countries. Thus, generalization of our findings should be undertaken with caution.

Content and construct validity of the Comprehensive ICF Core Set for OA was supported from the Singaporean perspective. Some categories, especially in *environmental factors*, need to be studied further in different sociocultural contexts.

REFERENCES

- Altman R, Asch E, Bloch D, et al. Development of criteria for the classification and reporting of osteoarthritis. Classification of osteoarthritis of the knee. Diagnostic and Therapeutic Criteria Committee of the American Rheumatism Association. *Arthritis Rheum* 1986;29:1039-49.
- Arden N, Cooper C. Osteoarthritis: epidemiology. In: Arden N, Cooper C, editors. *Osteoarthritis handbook*. London: Taylor & Francis; 2006:1-22.
- Sharma L, Felson DT. Studying how osteoarthritis causes disability: Nothing is simple. *J Rheumatol* 1998;25:1-4.
- Bellamy N, Carette S, Ford PM, et al. Osteoarthritis antirheumatic drug trials. III. Setting the delta for clinical trials — results of a consensus development (Delphi) exercise. *J Rheumatol* 1992;19:451-7.
- Hochberg MC, Altman RD, Brandt KD, et al. Guidelines for the medical management of osteoarthritis. II. Osteoarthritis of the knee. *American College of Rheumatology. Arthritis Rheum* 1995;38:1541-6.
- Hochberg MC, Altman RD, Brandt KD, et al. Guidelines for the medical management of osteoarthritis. I. Osteoarthritis of the knee.

- American College of Rheumatology. *Arthritis Rheum* 1995;38:1535-40.
7. Bellamy N, Buchanan WW, Goldsmith CH, Campbell J, Stitt LW. Validation study of WOMAC: a health status instrument for measuring clinically important patient relevant outcomes to antirheumatic drug therapy in patients with osteoarthritis of the hip or knee. *J Rheumatol* 1988;15:1833-40.
 8. Lequesne MG. The algofunctional indices for hip and knee osteoarthritis. *J Rheumatol* 1997;24:779-81.
 9. Guyatt GH, Feeny DH, Patrick DL. Measuring health-related quality of life. *Ann Intern Med* 1993;118:622-9.
 10. Cieza A, Brockow T, Ewert T, et al. Linking health-status measurements to the International Classification of Functioning, Disability and Health. *J Rehabil Med* 2002;34:205-10.
 11. Cieza A, Geyh S, Chatterji S, Kostanjsek N, Ustun B, Stucki G. ICF linking rules: an update based on lessons learned. *J Rehabil Med* 2005;37:212-8.
 12. Sigl T, Cieza A, Brockow T, Chatterji S, Kostanjsek N, Stucki G. Content comparison of low back pain-specific measures based on the International Classification of Functioning, Disability and Health. *Clin J Pain* 2006;22:147-53.
 13. World Health Organization. *Towards a common language for functioning, disability and health: ICF*. Geneva: World Health Organization; 2002.
 14. Stucki G, Cieza A, Ewert T, Kostanjsek N, Chatterji S, Ustun TB. Application of the International Classification of Functioning, Disability and Health (ICF) in clinical practice. *Disabil Rehabil* 2002;24:281-2.
 15. Stucki G, Ewert T, Cieza A. Value and application of the ICF in rehabilitation medicine. *Disabil Rehabil* 2002;24:932-8.
 16. Cieza A, Ewert T, Ustun TB, Chatterji S, Kostanjsek N, Stucki G. Development of ICF Core Sets for patients with chronic conditions. *J Rehabil Med* 2004;44 Suppl:9-11.
 17. Ware JE, Kosinski M, Dewey JE. *How to score version 2 of the SF-36 Health Survey*. Lincoln, RI: QualityMetric Inc.; 2000.
 18. Sangha O, Stucki G, Liang MH, Fossel AH, Katz JN. The Self-Administered Comorbidity Questionnaire: a new method to assess comorbidity for clinical and health services research. *Arthritis Rheum* 2003;49:156-63.
 19. Bellamy N, Buchanan WW. A preliminary evaluation of the dimensionality and clinical importance of pain and disability in osteoarthritis of the hip and knee. *Clin Rheumatol* 1986;5:231-41.
 20. Stucki G, Ewert T. How to assess the impact of arthritis on the individual patient: the WHO ICF. *Ann Rheum Dis* 2005;64:664-8.
 21. Cieza A, Geyh S, Chatterji S, Kostanjsek N, Ustun BT, Stucki G. Identification of candidate categories of the International Classification of Functioning, Disability and Health (ICF) for a generic ICF core set based on regression modelling. *BMC Med Res Methodol* 2006;6:36.
 22. Xie F, Thumboo J, Fong KY, et al. Are they relevant? A critical evaluation of the International Classification of Functioning, Disability and Health core sets for osteoarthritis from the perspective of patients with knee osteoarthritis in Singapore. *Ann Rheum Dis* 2006;65:1067-73.
 23. Bellamy N, Kirwan J, Boers M, et al. Recommendations for a core set of outcome measures for future phase III clinical trials in knee, hip, and hand osteoarthritis. Consensus development at OMERACT III. *J Rheumatol* 1997;24:799-802.
 24. Brazier JE, Harper R, Munro J, Walters SJ, Snaith ML. Generic and condition-specific outcome measures for people with osteoarthritis of the knee. *Rheumatology Oxford* 1999;38:870-7.
 25. Meenan RF, Gertman PM, Mason JH. Measuring health status in arthritis: the Arthritis Impact Measurement Scales. *Arthritis Rheum* 1980;23:146-52.
 26. Rabin R, de Charro F. EQ-5D: a measure of health status from the EuroQol Group. *Ann Med* 2001;33:337-43.
 27. Rejeski WJ, Shumaker S. Knee osteoarthritis and health-related quality of life. *Med Sci Sports Exerc* 1994;26:1441-5.
 28. Roos EM, Roos HP, Lohmander LS, Ekdahl C, Beynon BD. Knee Injury and Osteoarthritis Outcome Score (KOOS) — development of a self-administered outcome measure. *J Orthop Sports Phys Ther* 1998;28:88-96.